

ascending columns of air, as printed by Espy at page 167 of his *Philosophy of Storms*. The Editor has recently discovered that this reference to the Kite Club, as well as the whole of pages 161-168 of the *Philosophy*, is quoted by Espy from pp. 34-40 of an *Essay on Meteorological Observations*, by J. N. Nicolle, which essay is dated May 6, 1839. Nicolle, in these pages, fully indorses Espy's views, which, as he says, are recommended by the American Philosophical Society of Philadelphia, and it is quite possible that he has simply reproduced some one of Espy's numerous writings, however, Nicolle's pamphlet enables us to conclude with considerable confidence that the report of the Franklin Kite Club was published in or before 1838. No copy of this report has, as yet, been discovered, and it is considered exceedingly desirable that copies should, if possible, be deposited in some of the larger public libraries, where they will be preserved on account of their historical interest.

If any of the older meteorological observers possess copies of the circulars and instructions issued by Espy or the Joint Committee, during the years 1834-40, or if they possess newspapers containing reports of Espy's lectures, or any other matters of interest in the history of meteorology, the Editor will be glad to hear from them. Old manuscripts, papers, and pamphlets that have descended from one generation to another until they have become an incubus should never be destroyed or sold for waste paper until some competent librarian or historian has had an opportunity to examine them thoroughly and decide whether they are not worth purchasing and preserving permanently.

#### THE KITE AS USED BY ESPY.

Even before the work done by the Franklin Kite Club we note that Espy used the kite to determine the altitude of clouds as a check upon his computations, based on the dew-point of the air near the surface of the ground. His active mind had perceived that the altitude of the base of a cloud depends upon the rate of cooling of ascending moist air. The following paragraph must have been written between 1833 and 1837, and is quoted from page 75 of Espy's *Philosophy of Storms*:

I would recommend that gentlemen residing in mountainous districts, where the clouds sometimes form on the sides of the mountains, should ascertain the perpendicular heights of these clouds at their bases and see whether they are 100 yards high for every degree of Fahrenheit by which the temperature of the air is above the dew-point at the moment of their formation. \* \* \* Since writing the above a kite was sent up into the base of a cloud and its height ascertained by the sextant and compared with the height calculated from the dew-point, allowing 100 yards for every degree by which the dew-point was below the temperature of the air, and the agreement of the two methods was within the limits of the errors of observation. In this case the base of the cloud was over 1,200 yards high. Moreover, the motions of the kite whenever a forming cloud came nearly over it proved that there was an upmoving column of air under it. I speak of cumulus clouds in the form of sugar loaves with flat bases.

In his third meteorological report, paragraph 81, written about November, 1850, and reprinted also as paragraph 81 in his fourth report, Espy says:

When the kite experiments mentioned before were performed and the kite was allowed to stay up in the air many hundred yards high in the night, by touching with the hand the reel on which the wire was wound which was attached to the kite, the *fingers became luminous*, quite brilliant, though no sensation of a shock was produced; but by touching the wire itself a very pungent shock was experienced; and one day in particular when the kite entered the base of a forming cloud the discharge of electricity down the wire, snapping to an iron conductor stuck in the ground, terminating at its upper end within an inch or two of the wire, became fearful.

In the case of the meteoric rivers (i. e., cloudbursts) the friction of the water through the air in falling might be supposed to generate electricity which rendered them luminous; but the friction of the wind on a kite eight feet square could evidently not be sufficient to account for the great quantity of electricity constantly passing down the wire; indeed the shock on touching the wire became quite sharp when the

kite was elevated a few hundred feet, even in a clear sky. *After all, it must be acknowledged that the utility of electricity is yet to be discovered, as also its mode of generation and the part it plays in storms.*

The evolution of latent caloric in the formation of cloud is undoubtedly adequate to account for all the phenomena attending storms, with but two or three exceptions noticed before, which may probably be produced by electricity—in a mode, however, not yet exactly known.

In the paragraphs preceding No. 81 there is nothing relative to kite experiments; it seems likely that Espy intended to refer to his *Philosophy of Storms* and to the kite experiments made by himself and the Franklin Kite Club in Philadelphia. In this case we see that as early as 1836 metallic wire was used instead of string in Philadelphia.

#### THE KITE USED IN 1822 BY FISHER.

The Editor has several times called attention to the fact that the first to apply the kite to meteorological investigations was the eminent Prof. William Wilson, of Glasgow University, who in 1749 obtained the temperatures at great elevations by means of self-registering minimum thermometers carried up by means of a kite or tandem of kites. In a recent note on this subject by our distinguished co-laborer Mr. G. J. Symons, the learned editor of the *Monthly Meteorological Magazine*, he states that the next use of the kite for determining temperatures was that made by Rev. George Fisher and Capt. Sir William Edward Parry (at the Island of Igloolik, latitude 69° 21' N., longitude 81° 42' W., during Parry's "second voyage" in 1822-23). Mr. Symons quotes the account as published by Harvey, in the *Encyclopædia Metropolitana*, article, "Meteorology," published in 1834. The experiment by Fisher is one that had long been known to the present Editor, although he was not until now aware of Harvey's reference to it. The original account quoted by Harvey is contained in a letter from Fisher addressed to Dr. Thomas Young as editor of the *Quarterly Journal of Science and Arts*, published by the Royal Institution of Great Britain (see Vol. XXI, 1826, page 348); it is followed by some notes by Dr. Young, on page 359, both of which we quote as follows:

WANTED VICARAGE, ESSEX, 23d Feb., 1826.

I have enclosed some of the observations upon the refraction at low temperatures and altitudes, made at the island of Igloolik, N. E. coast of America. And as the law of variation in the temperature of the atmosphere at different heights is connected with the theoretical investigation of the subject, I take the opportunity of mentioning an experiment made by Captain Parry and myself for determining it.

This was done by means of a paper kite, to which was attached an excellent register thermometer, in a horizontal position. Its height above the level of the frozen sea, upon which the experiment was made, was determined by two observers in the same vertical plane, taking its altitude at the same time above the distant horizon; and from thence its height was computed. The greatest height observed was 379 feet, at which height it was nearly stationary for about a quarter of an hour. It probably, however, had been more than 400 feet above the sea. After an unsuccessful attempt, the experiment was made under very favourable circumstances, the kite being sent up and caught in coming down, without the slightest shake. The indices had not altered their position in the slightest degree, and they would have indicated any variation of temperature, had it existed, to less than a quarter of a degree Fahr. The temperature at the time was -24° Fahr.

I have also enclosed Dr. Brinkley's table of refractions, adapted to temperatures as low as -50° Fahr., which he was kind enough to send me.

From, Dear Sir, yours truly.

GEO. FISHER.

Note on the above by Dr. Thomas Young on page 359:

The observations of Mr. Fisher and of Mr. Foster fully justify the remark already made in the thirteenth number of these collections, (Vol. XV, p. 128), that the refractions at low temperatures, as indicated by Dr. Young's table, which are found to be somewhat greater than those which Mr. Groombridge has observed in this country, would probably be found to be less in excess when applied to colder climates. That they would, however, have been actually so much in defect as these observations have demonstrated, could not have been foreseen without actual trial. The theory is indeed greatly illustrated by Mr. Fisher's very valuable experiment with the kite, which shows that the law of decrease of temperature must be supposed to be very differ-

ent in the arctic regions from that which prevails in more moderate latitudes; but it serves fully to prove the impossibility of forming any hypothesis respecting the constitution of the atmosphere which shall be universally correct.

Following the above Dr. Young gives some notes as to the effect of a change of a degree Fahrenheit on the astronomical refraction.

Shortly after this time, viz, in the *Edinburgh Journal of Science*, 1827, Vol. VI, page 246, Sir Thomas Brisbane quotes Fisher's experiments and Dr. Young's remarks in connection with observations made at Port Macquarie, Van Diemens Land, in June, 1824, at an upper and lower station, for the purpose of determining the decrease of temperature with altitude.

In the *Edinburgh Journal* for January, 1827, Vol. VI, p. 146, Brewster, as editor, commenting on the hourly observations proposed by the Royal Society of Edinburgh, used the following words:

To those meteorologists who have sufficient leisure and the means of performing such experiments, we would recommend the use of kites or of balloons for ascertaining the temperature and state of the upper atmosphere. The Earl of Minto has obtained several very interesting results by the use of balloons.

The observations by the Earl of Minto here referred to were given in the subsequent volume, page 249, where it appears that small captive balloons were used up to a height of 1,340 feet. An observer ascended with the balloon; the height was varied frequently by letting out or pulling in the line. The rise of temperature after sunset at the upper station was well established.

Another account of the experiment by Rev. George Fisher is given at page 187 of the volume of scientific memoirs published at London, 1825, as the Appendix to Captain Parry's *Journal of the Second Voyage for the Discovery of the North-west Passage*. In the Appendix No. 2, on Atmospheric Refraction, on page 187, Mr. Fisher says:

It appears by an experiment that when the sea is covered with ice in the winter there is no sensible difference between the temperatures of the atmosphere at the surface of the ice and at the height of 400 feet above it. This was tried by means of a paper kite with an excellent register thermometer attached to it, the altitude of which was determined by two different observers at the time, at a given distance from each other and in the same vertical plane as the kite, and from which the perpendicular height of the kite above the level of the ice was computed. This experiment was tried under favorable circumstances at a temperature of  $-24^{\circ}$  F. The kite was sent up and caught in coming down without the thermometer being in the least disturbed, the indices of which did not show the slightest alteration although carefully compared before and after these experiments and the kite remained at the same height in the air for a considerable time.

There is nothing to show the special date on which this experiment was made, but it may be safely assumed to have been in February or March, 1823. Whether the upper temperature was lower or higher than that near the earth's surface would have been shown by Mr. Fisher's thermometer, since it appears to have been a self-registering Six thermometer in an iron case, whose two indices would respectively show the maximum and the minimum that occurred during each experiment. Of course the iron case or inclosure which protected this thermometer from accident also greatly increased its sluggishness from a thermometric point of view, and as the thermometer remained at its highest altitude only five or ten minutes, it could not be expected to settle a question of a difference of less than  $5^{\circ}$  F.

The preceding investigations seem to the Editor to have all been suggested by the active discussion that was in those days going on as to the formula for refraction in the atmosphere, in which Dr. Thomas Young and Mr. Ivory took a prominent part.

## ARCHIBALD ON KITES.

A little book has just been published in London, entitled *The Story of the Earth's Atmosphere*, by Douglas Archibald. This volume contains a very readable, popular account of the general composition, temperature, and circulation of the atmosphere, written by one who has himself contributed something to the progress of meteorology. From Chapter XIII we quote the following. After some remarks on balloons and flying machines, Mr. Archibald says:

When a plane surface is forced through the air, the upward pressure of the air is mostly concentrated near its front edge. If the surface extended far back from the edge, its weight would act at some distance from the front edge. Consequently, the unbalanced pressure of the air would tend to turn the plane over backwards. If, however, its width were small, the weight would act so close to where the resistance acts in the opposite direction that the forces would neutralize each other and stability ensue.

Mr. Hargrave has adopted this principle in his cellular or box kite, whose construction is sufficiently obvious to render detailed description unnecessary.

The dimensions are as follows: The length of each cell (from right to left) is 30 inches, and the width and height and opening between are about 11 inches; but these dimensions may vary so long as the two cells together form a nearly square area. An important feature of this peculiar, tailless kite consists of the covered-in sides. These ensure stability even better than two planes bent upward in V shape, such as the wings of the kestrel when hovering, and they prevent the kite from upsetting, very much as the sides of a ship give it stability.

Mr. Maxim once showed the advantage of such side planes by a simple experiment in which a piece of paper, when held horizontally and let fall to the floor, is seen to execute a series of zigzags in the air, frequently ending in its complete overthrow; whereas when the same piece of paper is folded up round the edges like a boat, it sails to the floor quite evenly and in a straight line. \* \* \*

The kite was first invented by the Chinese General Han Sin in 206 B. C., for use in war, and was frequently employed after that date in China by the inhabitants of a besieged town to communicate with the outside world. After this kites appear to have degenerated into mere toys.

At the middle of the present century, however, Pocock of Bristol employed them to draw carriages, and is said to have traveled from Bristol to London in a carriage drawn by kites. They were also occasionally employed to measure the temperature of the upper air, by Admiral Back, on the *Terror*, and Mr. Birt, at Kew, in 1847.

These observations had been quite forgotten when the author first suggested the employment of kites for systematic observations in 1883. It has since been discovered that Dr. Wilson, of Glasgow, as long ago as 1749, resuscitated kites from their long burial with a similar idea of employing them to measure temperature.

In the author's experiments, steel wire was first employed to fly them with. Two kites of diamond pattern, made of tussore silk and bamboo frames, were flown tandem, and four self-recording Biran anemometers, weighing  $1\frac{1}{2}$  pounds each, were attached at various points up the wire. Heights from 200 to 1,500 feet were reached by the instruments, and the increase of the average motion of the atmosphere was measured on several occasions for three years. Kites were also employed first, by the author, in 1887, to photograph objects below by means of a camera attached to the kite wire, the shutter being released by explosion. Since that time kite photography has leapt into popularity and has been successfully practised by M. Batut, in France, Capt. Baden Powell, in England, and Eddy, in New Jersey. \* \* \*

It was further suggested by the author, in 1888 (*Les Cerfs Volants Militaires*. Bibliothèque des Connaissances Militaires. Paris, 1888.), that kites could be used for various purposes in war as well as science.

Since then Capt. Baden Powell, in May, 1895, read a paper on "Kites, their uses in War." In both these publications it was pointed out that kites possessed several distinct advantages over balloons; next, that they could be applied to all the purposes for which balloons could be employed, such as signalling, photography, torpedo projection, carrying despatches between vessels, and, lastly, they could be employed to raise a man for purposes of reconnaissance.

## EFFICIENCY OF WINDMILLS.

In his *Story of the Earth's Atmosphere*, Mr. Douglas Archibald, says:

It is estimated that there are more than a million windmills in the United States alone. The useful efficiency of windmills, especially in the modern geared form, is comparable with that of the best simple steam engines.

A geared modern wheel, 20 feet in diameter, will develop 5-horse power in an 18 mile an hour breeze, and can be applied to work agricultural machinery and dynamos for electric lighting. With a single wheel of this size Mr. McQuesten, of Marblehead Neck, Mass., U. S.